This document is guaranteed to be current only to issue date.

Some Mars Global Surveyor documents that relate to flight operations are under revision to accommodate the recently modified mission plan.

Documents that describe the attributes of the MGS spacecraft are generally up-to-date.

**542-409, Volume 5, Part 1**

# Mars Global Surveyor

# Mission Operations Specifications

# Volume 5: Interfaces

# Part 1: Software Interface Specification

# Final

January 26, 1996

**Jet Propulsion Laboratory**
California Institute of Technology

**JPL D-12369, Volume 5, Part 1**

542-409, Vol. 5

# MARS GLOBAL SURVEYOR

## MISSION OPERATIONS SPECIFICATION

VOLUME 5

Part 1: Software Interface Specifications

# Final

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542-409, Vol. 5

# MARS GLOBAL SURVEYOR

## MISSION OPERATIONS SPECIFICATION

VOLUME 5

Part 1: Software Interface Specifications

Prepared:

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Mars Global Surveyor Project

Jet Propulsion Laboratory
California Institute of Technology

JPL D-12369, Vol. 5

DOCUMENT CHANGE LOG

| Effective Date | Version | Incorporated MCRs | Affected Sections |
|---|---|---|---|
| 01/26/96 | Original | N/A | All |
| 02/14/96 | | (01), (012) | Document Change Log - added to the Original document (to be inserted following signature page);<br><br>Table of Contents - updated to reflect MGS SIS EAE003 Rev. A supplement;<br><br>MO SIS EAE003 dated 01/24/91 revised and reissued as MGS SIS EAE003 Rev A dated 01/25/96, which is incorporated into and supplements this document |

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Table of Contents

# Section 1

# Introduction

## 1.1 PURPOSE AND SCOPE

Volume 5, Part 1 specifies software interfaces of Mars Global Surveyor (MGS) Mission Operations System (MOS). It is the controlling document of MGS MOS interfaces for the duration of the Project.

## 1.2 INTERFACES DESCRIPTION

Software interfaces are described in the form of Software Interface Specification (SIS). A SIS covers interfaces between hardware/software components. All identified interfaces are listed in Section 1.7. Each SIS includes a signature page, a brief summary, and a detailed specification of the software interface (as outlined in Appendix A).

Interfaces in which a user team simply accepts and reads a file are defined in Volume 5, Part 2, Operational Interface Agreements.

## 1.3 RESPONSIBILITIES

The design and negotiation of each interface is the responsibility of the Cognizant Interface Engineer; generally the cognizant engineer of the element which produces the product unless otherwise negotiated. The responsibility embraces generation of the agreements, successful negotiation among all parties to these agreements culminating in signed agreements, and renegotiation required as the result of a change proposal on behalf of any party to the agreements. Further, for interfaces defined by reference to existing documentation, the responsible organization of the cognizant interface engineer will monitor the referenced documentation and assure that it is maintained by the cognizant institution and updated consistently with Project requirements.

SISs require the signatures of both generating element engineer(s) and receiving engineer(s) for each affected interface, and the signature of the cognizant interface engineer and the Ground Data System Software System Engineer.

## 1.4 CHANGE CONTROL

This document is subject to the MGS Project Change Control as documented in the MGS Mission System Configuration Management Plan. Any change to any interface agreement included herein requires Mission System Change Control Board approval. Interfaces which are specified by reference to a JPL institutional document will be controlled by Project participation on the institutional change control boards having cognizance over those interfaces.

## 1.5 INTERFACE VALIDATION

The interface validation process is addressed in the Vol. 6, Testing Documents, included therein is a matrix that describes the test cases and validation status of each interface defined in this document.

## 1.6 SIS DEFINITION

A SIS covers interfaces between hardware/software components. Four possible situations may appear:

1. *A SIS will be written by another organization (external SIS) such as multimission DSN or MGSO specifications which "completely" covers all information required by the project*: Cognizant Interface Engineer needs to write only signature page, summary page and PDB information in addition to attaching external SIS.

2. *More than one external SIS covers all required information:* In addition to the signature page, PDB information and summary page, the Cognizant Interface Engineer needs to identify how these SISs are related to each other for this MGS interface. External SIS's need to be included.

3. *External SIS's exist, but do not "completely" cover all information required by the project:* A SIS following the attached SIS outline and written by the Cognizant Interface Engineer is required; however, where applicable, a reference to the existing SISs) and their parts should be specified. In addition, the signature page and PDB information shall be provided.

4. *An external SIS does not exist:* A SIS following the attached SIS outline, a signature page, PDB information and a summary page should be written and prepared by the Cognizant Interface Engineer.

## 1.7 SOFTWARE INTERFACES LISTING

Table 1 is a list of the software interfaces active for MGS. Figure 1 provides a graphical representation of the GDS internal interfaces.

In many cases, the MGS Project SIS is simply an endorsement of a multimission specification. Deep Space Network specifications are contained in document 820-13; Rev A, DSN System Requirements, Detailed Interface Design. You can access the DSN interfaces electronically at the DSN Interface Server, http://jaguar.jpl.nasa.gov/.

Multimission Ground System Organization (MGSO) specifications are contained in the Advanced Multimission Operations System (AMMOS) library. You can access the MGSO interfaces electronically at the MGSO AMMOS Documentation Homepage, http://div390-www/ammos_docs/.

Note that the original SIS's produced for MO were widely distributed as hardcopy products. (MO document 642-315, Vol. 5, Part 1/JPL D-3822.) In many cases, an electronic copy was not available to MGS personnel. In keeping with MGS policies toward electronic documentation and minimizing cost, SISs which are unchanged from MO are not reissued. These reside in the GDS library and JPL vellum files. As updates are accomplished for MGS, electronic versions will be included on the Project document server.

APPENDIX A

SIS TOPICAL OUTLINE

1.0 Introduction

1.1 Purpose

1.2 Scope

1.3 Applicable Documents

1.4 Functional Description

1.4.1 Data Content Summary

1.4.2 Source and Transfer Method

Describes where this interfaces is created, and how it is transferred to recipient(s).

1.4.3 Recipients and Utilization

Describes who will receive this interface and what their utilizations are.

1.4.4 Pertinent Relationships with other Interfaces

Describes, if any, other SIS's needed to interpret this interface.

1.5 Assumption and Constraints

If there is any assumption(s) made in the generation of this document or file, it should be stated here. Also, if there are any usage constraints, or generation constraints, they should be stated here.

2.0 ENVIRONMENT

2.1 Hardware Characteristics and Limitation

This paragraph describes any information related to Hardware/Software in order to use this interface.

2.1.1 Special Equipment & Device Interfaces

2.1.2 Special Setup Requirements

### 2.2 Interface Medium Characteristics

Describe characteristics of the interface media. If the interface media is the PDB, describes the key words of this interface used in the PDB catalog.

### 2.3 Failure Protection, Detection and Recovery

### 2.4 End-of-File convention

## 3.0 ACCESS

### 3.1 Access Tools

Describe particular programs, utilities, tools needed to access the data.

### 3.2 Input/Output Protocols

### 3.3 Timing and Sequencing Characteristics

### 3.4 PDB Information

Describe PDB data type and associated catalog attributes (if applicable).

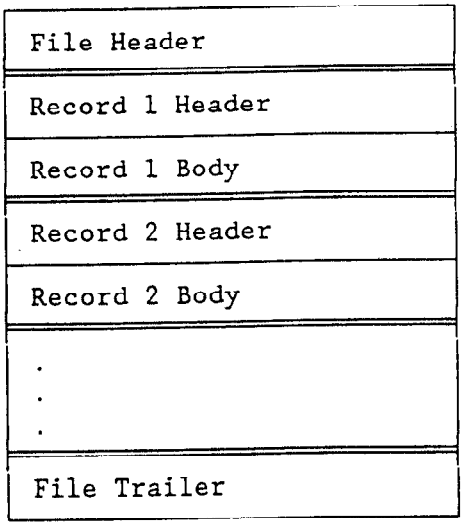
## 4.0 DETAILED INTERFACE SPECIFICATIONS

### 4.1 Labeling and Identification

This paragraph will describe the version, file naming conventions.

### 4.2 Structure and Organization Overview

The overall file structure is described here. For example, the organization of file header and trailer in conjunction with data records (record header if any). The following diagram is an example.




## 4.3 Substructure Definition and Format

### 4.3.1 Header/Trailer Description Details

This paragraph should give detailed description of the user-defined headers, trailers and CHDO headers. Other SFDU headers and trailers should be referenced to the "SFDU Envelop SIS", to be produced by the Data Storage and Retrieval Element (DSRE) of the Ground Data System.

### 4.3.2 Data Description Details

This paragraph describes the detailed format of the data record in a bit level.

## 4.4 Volume, Size and Frequency Estimates

Describe, by phases :

1. the size of a object derived from the sizes of record, headers and trailers,

2. the frequency of production,

3. approximate number of objects, and

4. approximate number of objects required on-line.

# MGS Software Interface Specifications
## Summary

92 SIS's were referenced in MO Volume 2

30 are deleted as not needed for MGS operations

63 SIS's are on the active list for MGS

40 have no change from Mars Observer

5 are reassigned to Engineering Analysis
(EAE019/DAC/014, EAE021/DSR017, EAE022/DAC016, EAE023/DAC017, EAE025/DAC029)

13 are files with updated multimission SIS references

5 are revised for MGS:

| | | |
|---|---|---|
| EAE003 | Rev A | Angular Momentum |
| EAE006 | Rev A | SCT Report |
| NAE003 | Rev B | OPTG |
| NAE006 | Rev B Chg 1 | MPF |
| PSE018 | new | SEQ Conditions |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| DACE001 | DSN Viewperiod File | SFOC-1-SEG-DSN-V | DAC_NOCC | (DSR) EAS NAS PSS | nc |
| DACE003 | DSN Allocation File | SFOC-1-SEG-DSN-A | DAC_NOCC | (DSR) NAS PSS | nc |
| DACE004 | Archival Tracking Data File | TRK-2-25 | DAC_NOCC | (DSR) SSS NAS | nc |
| DACE005 | Orbit Data File (ODF) | TRK-2-18 | DAC_NOCC | (DSR) SSS NAS | nc |
| DACE006 | Media Calib Data File | TRK-2-23 | DAC_NOCC | (DSR) SSS NAS | nc |
| DACE007 | Time & Polar Motion File | TRK-2-21 | DAC_NOCC | (DSR) SSS NAS | nc |
| DACE009 | Tracking Station Locations and Err File | 810-5, GEO-10 | DAC_text | (DSR) SSS | nc |
| DACE011 | Raw DSN Monitor Blocks | MON-5-15 | DAC_CCP | DAC_TIS (DSR) SSS | nc |
| DACE012 | S/C Channelized Engr Data | SFOC-5-TIS-*DU-MGSSFDU | DAC_TIS | (DSR) EAS SSS DAC | new ref 08/23/95 |
| DACE013 | Channelized Monitor Data | SFOC-5-TIS-*DU-MGSSFDU | DAC_TIS | (DSR) DAC NAS EAS SSS | new ref 08/23/95 |
| DACE014 | (see EAE019) | | | | |
| DACE016 | (see EAE022) | | | | |
| DACE017 | (see EAE023) | | | | |
| DACE022 | Weather Data | TRK-2-24 | DAC_TSAC | (DSR) SSS | nc |
| DACE025 | DSN Formatted Cmd File (CMD_DSN, aka GCMD) | SFOC-1-CMD-MO-GNDCMDFIL | DAC_CMD | (DSR) PSS(r) DAC | nc |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| DACE029 | (see EAE025) | | | | |
| DACE034 | QQC Records | SFOC-2-TIS-ANY-MOTELEM | DAC_TIS | (DSR) SSS DAC | nc |
| DACE037 | Expanded Channel Data Record (ECDR) | SFOC-1-DMD-ANY-EXPCHAN | DAC_DMD | EAS SSS (DSR) | nc |
| DACE040 | S/C ENG Telemetry Packet Data Record | SFOC-5-TIS-*DU-MGSSFDU | DAC_TIS | (DSR) EAS SSS | new ref 08/23/95 |
| DACE043 | Raw Telemetry Frames | SFOC-1-GIF-DSN-MOGCFTLM | DAC | DAC (Note: not stored on PDB/TDS) | nc |
| DACE044 | Radio Science Open Loop SCP & SSI Data | RSC-11-12 | DAC_DSPR | (DSR) SSS | nc |
| DACE045 | Radio Science Open Loop SCP Data Decom Map | RSC-11-12 | DAC_DSPR | (DSR) | nc |
| DACE046 | Radio Science Open Loop Data | RSC-11-11 | DAC_DSPR | (DSR) SSS [PDS - via RS Team] | nc |
| DSR001 | Event Kernel Data Record | SFOC-1-NAF-Any-EKernel | DSR_NAIF | (DSR), SSS, DAC_rtot | nc |
| DSR004 | MAG/ER Packet Data Record | | DAC_TIS | SPA, SSS | nc |
| DSR005 | TES Packet Data Record | | DAC_TIS | SSS SPA | nc |
| DSR006 | MOC Packet Data Record | | DAC_TIS | SSS SPA | nc |
| DSR007 | MOLA Packet Data Record | | DAC_TIS | SSS SPA | nc |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| DSR012 | QQC Summary Report File | G Smith | DSR_custom | (DSR) EAS SSS | nc |
| DSR017 | (see EAE021) | | | | |
| DSR019 | SPICE Leapseconds File | SFOC-1-NAF-Any-LSKernel | DSR_NAIF | (DSR) | nc |
| DSR020 | SPICE SCLK File | SFOC-1-NAF-Any-SCLKernel | DSR_NAIF | (DSR) | nc |
| EAE003 | Angular Momentum Desaturation | P.Esposito | EAS_AMDGEN | (DSR) NAS | Rev A 1/25/96 |
| EAE006 | SCT System Report File | J. Neuman | EAS_Word 6.0 | (DSR) SSS NAS | Rev A 1/26/96 |
| EAE007 | C-KERNEL (Reconstructed) | E. Dukes | EAS_attrec | (DSR) SSS NAS | nc |
| EAE008 | Maneuver Performance Data File | P.Esposito | EAS_MGPROP | (DSR) NAS_MOPS | nc |
| EAE011 | NAV Engr Information File | P.Esposito | EAS_ Word 6.0 | (DSR) NAS_no applic s/w | nc |
| EAE014 | Maneuver Implementation File | P.Esposito | EAS_MGPROP | (DSR) NAS_MOPS | nc |
| EAE019 | Telecom Performance Predictions | SFOC-1-TAS-Any-TelcomDat | EAS_TPAP | (DSR) DAC_TOPS | reassigned (formerly DACE014) |
| EAE020 | (same as PSE017) | | | | added 2nd ID for EAS |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| EAE021 | Spacecraft Clock Coefficient File | SFOC-1-DPS-Any-SCLKvSCET | EAS_SCLKGEN | (DSR) PSS SSS DAC | reassigned (formerly DSR017) |
| EAE022 | Engr Channel Parameter Table | O. Short SFOC ref: TBD | EAS_TDE | (DSR) DAC | reassigned (formerly DACE016) |
| EAE023 | Channel Conversion Language (CCL) File | O. Short | EAS_ Word 6.0 | (DSR) DAC | reassigned (formerly DACE017) |
| EAE025 | Decom Map | O. Short SFOC-1-TIS-Any-DecomMap | EAS_TDE | (DSR) DAC SSS | reassigned (formerly DACE029) |
| LUE001 | Launch Polynomials | P.Esposito | LUE | DAC NAS (change probable pending LVWG negotiations with MDAC) | nc |
| LUE003 | Injection Initial Conditions | TRK-2-17 | LUE | DAC NAS | new ref 2/28/94 |
| MMC004 | GDS Status Report | F.Hammer | editor | (DSR) | nc |
| NAE001 | Station Polynomial File | P.Esposito | NAS_DPTRAJ | (DSR) EAS_TPAP | nc |
| NAE002 | Light Time File | P.Esposito | NAS_DPTRAJ | (DSR) DAC_CMD PSS_SEQGEN, SEQTRAN EAS_SCLK_correl SSS | nc |
| NAE003 | Orbit Propagation & Timing Geometry File | P.Esposito | NAS_DPTRAJ | (DSR) PSS_SEQGEN SSS_SEQGEN EAS(r) | Rev B 1/15/96 |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| NAE006 | Maneuver Profile File | P.Esposito | NAS_MOPS | (DSR) EAS_MGPROP | Rev B Chg 1 9/25/95 |
| NAE007 | Planetary Constants Kernel File (PcK) | SFOC-1-NAF-Any-PcKernel | NAS_NAIF | (DSR) EAS(r) SSS(r) | nc |
| NAE008 | Astrodynamic Constants & Init Cond File | P.Esposito | NAS_DPTRAJ | (DSR) SSS(r) EAS(r) | nc |
| NAE009 | Spacecraft Ephemeris File (a.k.a. P-File) | P.Esposito | NAS_DPTRAJ (Note: does not reside on PDB) | DAC_DSNOT | nc |
| NAE011 | S&P Kernels (SPK) | SFOC-1-NAF-Any-SPKernel | NAS_NAIF | (DSR) EAS_STAR/TRANS SSS_MarsMapper | nc |
| NAE016 | Orbit Number File | P.Esposito | NAS_editor | (DSR) | nc |
| PSE001 | Predicted Events File | SFOC-1-SEQ-ANY-PEF | PSS_SEQGEN | (DSR) DAC_SEG SSS/NAS/EAS_SEQREVIEW | new ref 5/23/95 |
| PSE002 | Sequence of Events File | SFOC-1-SEG-Any-SOE | DAC_SEG | (DSR) NAS(r) EAS(r) SSS(r) | new ref 5/28/93 |
| PSE003 | Space Flight Operations Schedule File | SFOC-1-SEG-Any-SFOS | DAC_SEG | (DSR) NAS(r) EAS(r) SSS(r) | new ref 5/28/93 |
| PSE004 | Spacecraft Command Message File | SFOC-1-SEQ-CMD-SCMF | PSS_SEQTRAN | (DSR) DAC_CMD | new ref 10/28/94 |
| PSE005 | DSN Keyword File | SFOC-1-SEG-DSN-KEYWORDS | DAC_SEG | (DSR) DAC_NOCC PSS(r) | nc |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| PSE008 | Cumulative Memory Map | SFOC-3-SEQ-MEMFIL | PSS_ SEQTRAN | (DSR) EAS_MST | new ref 5/26/95 |
| PSE010 | S/C Activity Sequence File | SFOC-1-SEQ-Any-SASF | PSS_SEQGEN | (DSR) PSS EAS SSS _SEQGEN | new ref 5/25/95 |
| PSE011 | S/C Sequence File | SFOC-2-SEQ-SEQ-SSF | PSS_ SEQGEN | (DSR) PSS_SEQTRAN | new ref 4/25/94 |
| PSE013 | Desired Memory Word File | SFOC-3-SEQ-DMWF | PSS_SEQTRAN | (DSR) EAS_MST | new ref 7/10/95 |
| PSE017 | Trigger File (a.k.a. EAE020) | SFOC-1-SEG-Any-Trigger | EAS_editor SSS_editor NAS_editor | (DSR) DAC_SEG_soegen | new ref 8/20/93 |
| PSE018 | Conditions | SFOC-3-SEQ-CONDITIONS | PSS_SEQGEN | (DSR) EAS_spas PSE_SEQGEN SSE_ SEQGEN | new for MGS (replaces MOCHECK FINCON) |
| SSE001 | I-Kernel (IK) | SFOC-1-NAF-Any-IKernel | SSS_NAIF | (DSR) SSS_NAIF | nc |
| SSE004 | Instrument Status Report | | SSS_text | (DSR) EAS(r) | nc |

Notes:
The “Cognizant Engineer” field shows the ID of the multimission specification in cases where that is the real information source.

“nc” means no change from the Mars Observer (MO) version of the SIS; the MO version stands even though the names have changed.

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|

"new ref" means the multimission spec has been updated since the MO version. In general, MGS will not produce new cover and signature pages just because of an update in the DSN or SFOC references. However, principals will be notifed of such updates.

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| Following SIS/files are all deleted. I can't find any support for keeping these active. Any comments, objections, better ideas - notify Rich Benson. | | | | | |
| ~~DACE002~~ | ~~Command Database~~ | | ~~**EAS**~~ | ~~DAC (DSR) PSS EAS~~ | deleted |
| ~~DACE020~~ | ~~Command Report [TBD]~~ | | ~~DAC~~ | ~~EAS DSR~~ | |
| ~~DACE031~~ | ~~DSN-GIF MGDS Gateway~~ | | ~~DAC~~ | ~~DAC~~ | |
| ~~DACE041~~ | ~~Command~~ Transmission Protocol | SFOC-1-DSN-CMD-CMDMSG | DAC_CMD | DAC_CPA | delete |
| ~~DACE042~~ | ~~Command Translation Table~~ | | ~~DAC~~ | ~~DAC EAS PSS (DSR)~~ | |
| ~~dace047~~ | ~~ascii trk dat file~~ | ~~per espo11/21/95~~ | | | |
| ~~DACE048~~ | ~~Browser Config. Files~~ | | ~~DAC~~ | ~~SSS, DAC, (DSR)~~ | |
| ~~DACE049~~ | ~~DMD TDL File~~ | | ~~DAC~~ | ~~SSS, DAC, (DSR)~~ | |
| ~~DSR011~~ | ~~Raw Data Query Results File~~ | | ~~DSR~~ | ~~EAS SSS~~ | delete |
| ~~DSR013~~ | ~~Database Catalog Search Results File~~ | | ~~DSR~~ | ~~EAS SSS~~ | deleted |
| ~~DSR015~~ | ~~PDB Objects and Attributes~~ | | ~~ALL~~ | ~~DSR~~ | deleted |
| ~~DSR016~~ | ~~Inputs to E-KERNEL~~ | | ~~PSS, SSS~~ DAC, [EAS] | ~~DSR~~ | deleted |
| ~~EAS017~~ | ~~Stream Data Extract Command Line Input IF~~ | | ~~EAS SSS~~ | ~~DSR~~ | |
| ~~EAS018~~ | ~~Database Catalog~~ | | ~~EAS SSS~~ | ~~DSR~~ | deleted |

**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| ~~———~~ | ~~Command Line Input I/F~~ | | | | |
| ~~LUE002~~ | ~~Predicted Injection Error Matrix~~ | ~~P.Esposito~~ | ~~LUE~~ | ~~NAS~~ | delete? |
| nae004 | planet ephem | per esposito 24 oct 95 | | | |
| ~~NAE005~~ | ~~Satellite Ephemeris and Errors File~~ | ~~P.Esposito~~ | ~~NAS~~ | ~~NAS (DSR)~~ | delete? |
| ~~NAE015~~ | ~~Solar Coronal Model Correction (memorandum)~~ | ~~P.Esposito~~ | ~~DAC~~ | ~~NAS~~ | delete |
| ~~PSE014~~ | ~~Spacecraft Checkout Station Command Data File~~ | | ~~PSS~~ | ~~Spacecraft System~~ | delete |
| ~~SSE005~~ | ~~Instrument Power~~ Profile | ~~B.Brooks~~ | ~~SSS_text~~ | ~~PSS (DSR) EAS~~ | delete |
| DSRxx | Telemetry Dictionary | O. Short | SCT | DAC, SSS, PSS, EAS, NAS | cancel |
| DSR0xx | Command Dictionary | O. Short | SCT | DAC, SSS, PSS, EAS, NAS | cancel |
| DSR0xx | Block Dictionary | J. Neuman | SCT | DAC, SSS, PSS, EAS, NAS | cancel |
| DSR021 | Flight Rules | J. Neuman | SCT | DAC, SSS, PSS, EAS, NAS | cancel |
| (No software reads the dictionary files directly, SIS proposal was simply to allow storage on the PDB. Commitment to maintain Project document servers eliminates dependence on PDB for life of mission storage.) | | | | | |
| VTL001 | VTL Tlm stream | | VTL | DAC_cta21 | delete - covered by TTACS |
| VTL002 | VTL Sequence Output | | VTL | EAS | delete - STL accepts std inputs |
| VTL003 | VTL Miscomp. Events | | VTL | EAS | delete - std products used |

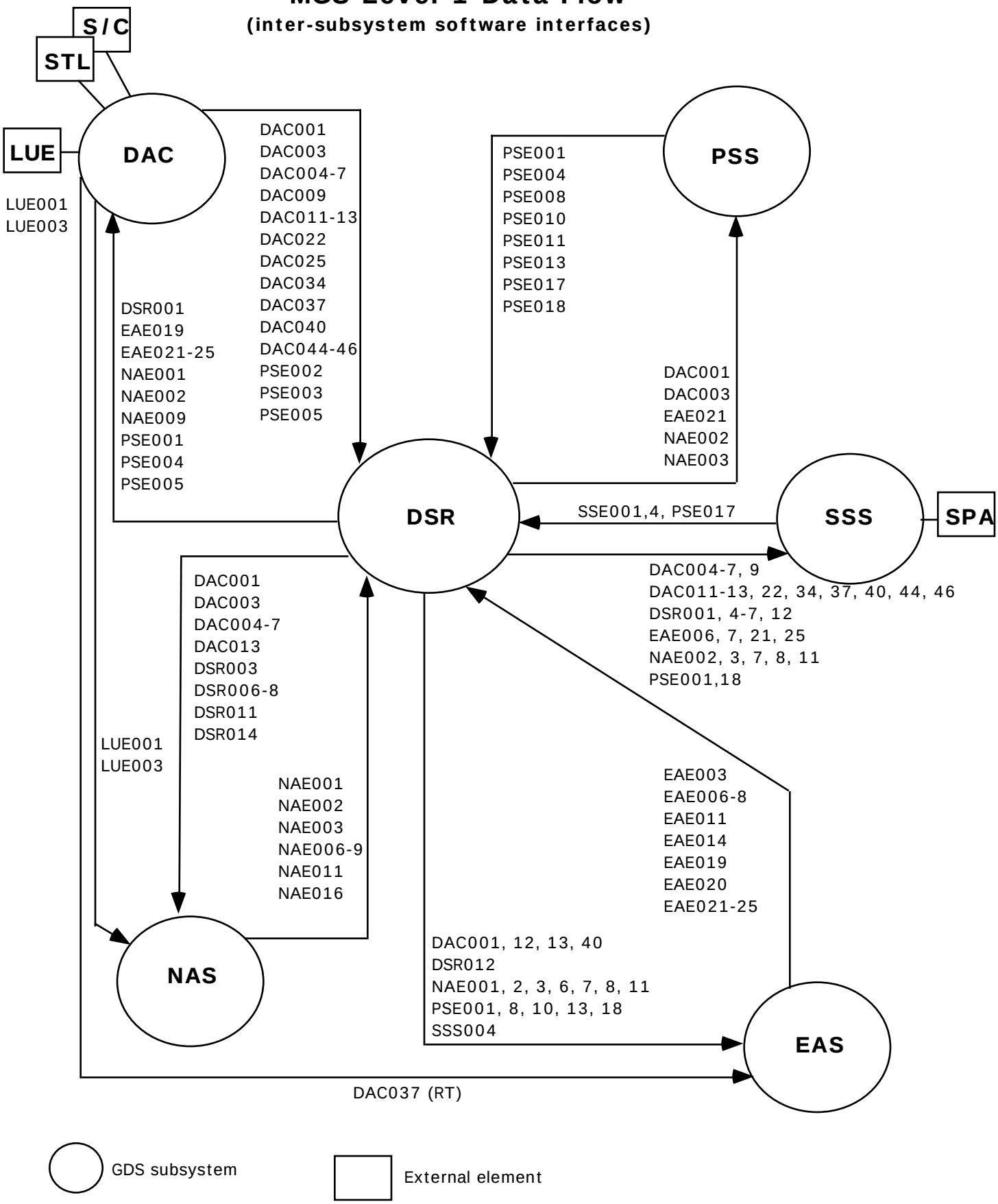
**Table 1. MGS Software Interface Specification List**

| I/F ID | I/F TITLE | Cog Engineer | Generating Subsystem(s) | Receiving Subsystem(s) | Status |
|---|---|---|---|---|---|
| VTL004 | VTL Memory Dump | | VTL | EAS | delete - std products used |
| VTL005 | VTL Sim Runlog | | VTL | EAS | delete - internal to STL |
| VTL006 | VTL Tape to Sim | | VTL | DAC_Sim | delete - covered by TTACS |

Note: The parenthetical (r) indicates a file is received for review only - it is not required by the receiving subsystem.

# MGS Level 1 Data Flow

**(inter-subsystem software interfaces)**




26 Jan 96

**542-409, Volume 5, Part 1, EAE003, Rev A**

**MARS GLOBAL SURVEYOR**

**Software Interface Specification**

# Angular Momentum Desaturation (AMD) File

January 25, 1996

**Jet Propulsion Laboratory**
California Institute of Technology

Author(s): J. E. Ekelund (orginal), S. Odiorne (Rev A)

# ANGULAR MOMENTUM DESATURATION FILE
Software Interface Specification
Revision A

25 January 1996

ABSTRACT: This document describes the form and syntax of the Angular Momentum Desaturation File generated by the Engineering Analysis Element (EAE).

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California 91109

# MARS GLOBAL SURVEYOR
# SOFTWARE INTERFACE SPECIFICATION

| | | | |
|---|---|---|---|
| Interface Title: Angular Momentum Desaturation (AMD) File | | | |
| Interface ID: | EAE003 | Version: | Revision A |
| Author: | J. E. Ekelund (original 24 Jan 91) J. Ekelund<br>Revision by S. Odiorne 26 Aug 95 | | |
| Generating Element Engineer: | Engineering Analysis | | |
| /s/ original signed by S Odiorne<br>Steve Odiorne | | 26 August 1995<br>Date | |
| Receiving Element Engineer: | Navigation Analysis | | |
| P. B. Esposito<br>P. B. Esposito | | 2/14/96<br>Date | |
| Receiving Element Engineer: | Data Storage and Retrieval | | |
| John A Swift<br>John Swift<br>MGS PDB Administrator | | 1-23-96<br>Date | |
| Approval Name and Title: | | | |
| P. B. Esposito<br>P. B. Esposito<br>Cognizant Interface Engineer | | 2/14/96<br>Date | |
| Richard D. Benson<br>R. D. Benson<br>GDS Software System Engineer | | 14 Feb 96<br>Date | |

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# DOCUMENT CHANGE LOG

| Change Letter | Date | Affected Portions |
|---|---|---|
| Original | 1/24/91 | All |
| Revision A | 1/25/96 | All; reissued whole document (deleted & renumber data records to reflect reduced MGS thruster set) [Sign-off complete 2/14/96] |

# List of TBD Items

| Page | Resolution Date | Item |
|---|---|---|

## TABLE OF CONTENTS

# 1. GENERAL DESCRIPTION

## 1.1. Content Overview

This Software Interface Specification (SIS) contains the description of the Angular Momentum Desaturation (AMD) File.

## 1.2. Scope

This document describes information pertaining to the spacecraft's hydrazine thrusters used in the unloading of momentum stored by the spacecraft's reaction wheels.

The format and syntax specifications in this SIS apply to all phases of the mission.

## 1.3. Applicable Documents

| | | |
|---|---|---|
| SFOC0038-05-25-01 | 10 Jan 94 | SFOC-1-CDB-ANY-CATALOGUE2 |
| SFOC009-01-00 | 13 Jun 90 | Data Dictionary |
| SFOC0038-01-14-01 | 4 Oct 90 | SFOC-1-CDB-MGN-TIMESFILE |
| SFOC0038-02-27-05 | 30 Aug 94 | SFOC-2-SYS-ANY-TIMEFORMS |
| | 1 Jul 90 | DPTRAJ-ODP User Reference Manual, SOM Vol. 1 and Vol. 2 |
| | 1 Jul 90 | DPTRAJ and ODP Interfaces and File Format Descriptions, SOM, Vol. 3 |

## 1.4. Subsystem Siting

### 1.4.1. Interface Location, Medium

This interface shall consist of a file generated in formatted FORTRAN.

### 1.4.2. Data Source, Destinations, and Transfer Method

The AMD File is generated on the EAE computer. The destination of the data is DPTRAJ within the NAE.

### 1.4.3. Generation Method and Frequency

The AMD file will be generated as required to support NAV operations. Angular Momentum Desaturations (AMDs) are autonomously activated.

### 1.4.4. Pertinent Relationships with Other Interfaces

None.

### 1.4.5. Labeling and Identification

Internal labeling of the AMD File is accomplished with header records as defined in Section 4.2.

## 1.5. Assumptions and Constraints

N/A

# 2. INTERFACE CHARACTERISTICS

## 2.1. Hardware Characteristics and Limitations

N/A

## 2.2. Volume and Size

This file will consist of 80 byte records consisting of 3 AMD header records and 16 data records. Other data will be the SFDU header and file trailer records.

## 2.3. Interface Medium Characteristics

The interface medium will be a computer disk file written in ASCII format.

## 2.4. Failure Protection, Detection, and Recovery Features

None.

## 2.5. End-of-File (or Medium) Conventions

$$EOF shall designate end-of-file.

# 3. ACCESS

## 3.1. Programs Using the Interface Data

See cover sheet.

## 3.2. Synchronization Considerations

N/A

## 3.3. Input/Output Protocols, Calling Sequences

N/A

# 4. DETAILED INTERFACE SPECIFICATIONS

## 4.1. Structure and Organization Overview

The Angular Momentum Desaturation File consists of the SFDU header, the AMD headers, and the AMD data records. Each will be described in the following sections.

## 4.2. Data Format and Definition

### 4.2.1. SFDU Data Description

The SFDU information and structure for the AMD File, in diagrammatic representation:

```
CCSD3ZS00001AAAAAAAA
    NJPL3KSOLO15BBBBBBBB
        <CR><LF>
        MISSION_NAME=MARS_GLOBAL_SURVEYOR;<CR><LF>
        SPACECRAFT_NAME=MARS_GLOBAL_SURVEYOR; <CR><LF>
        DATA_SET_ID=ANGULAR_MOMENTUM_DESAT; <CR><LF>
        FILE_NAME=amdfile.x; <CR><LF>
        PRODUCER_ID=EAS; <CR><LF>
        APPLICABLE_START_TIME=1993-001T00:00:00.000; <CR><LF>
        APPLICABLE_STOP_TIME=1993-001T15:38:31.800; <CR><LF>
        PRODUCT_CREATION_TIME-1990-12-21T10:43:000; <CR><LF>
    CCSD3RE00000BBBBBBBB
    NJPL3IS00255CCCCCCCC
```

In the actual AMD File, the following SFDU data is located at the end of the file, following the non-SFDU data, which is described in Section 4.2.2

```
    CCSD3RE00000CCCCCCCC
CCSD3RE00000AAAAAAAA
```

### 4.2.2 Non-SFDU Data Description

The non-SFDU portion of the file is described as follows:

#### 4.2.2.1. Header Record 1

Header record 1 identifies the file name.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-2 | "* " | Header character |
| 3-15 | "ANGULARMOMENT" | File identifier (general) |
| 16-27 | "HISTORY DATA" | File identifier (specific) |

#### 4.2.2.2. Header Record 2

Header Record 2 specifies the date and time of file creation.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-2 | "* " | Header character |
| 3-16 | "CREATION: SCT " | Specifies that the file creation is by the SCT |
| 17-27 | dd-mmm-yyyy | Day, month and year of file creation, eg 04-DEC-1989 (local date) |
| 28-28 | " " | Blank space |
| 29-36 | hh:mm:ss | Hours, minutes and seconds of file creation (local time) |

#### 4.2.2.3. Header Record 3

Header Record 3 contains the user input file description.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-2 | "* " | Header character |
| 3-80 | User input | File description input by user i.e., user free to put in his own information here |

#### 4.2.2.4. Data Record 1

Data Record 1 specifies momentum unload start time.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-12 | "STRT_TIME = " | Closest indication to when momentum begins to be imparted to the spacecraft. |
| 13-31 | yy-ddd/hh:mm:ss.fff | Unload event start time at the spacecraft (UTC). |

### 4.2.2.5. Data Record 2

Data Record 2 specifies momentum unload end time.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-12 | "STOP_TIME = " | Closest indication to when momentum ceases to be imparted to the spacecraft. |
| 13-31 | yy-ddd/hh:mm:ss.fff | Unload event stop time at the spacecraft (UTC). |

### 4.2.2.6. Data Record 3

Data record 3 through 14 represent data for each of the 12 possible thrusters that are numbered 01 through 12. This data record is for thruster number 01.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | "THRUSTER 01" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 01. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 01. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank Space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 01. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pule for thruster 01. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 01. |

### 4.2.2.7. Data Record 4

This data record is for thruster number 02.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 02" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 02. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 02. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 02. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 02. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 02. |

### 4.2.2.8. Data Record 5

This data record for thruster number 03.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 03" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 03. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 03. |

| | | |
|---|---|---|
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 03. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 03. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 03. |

### 4.2.2.9. Data Record 6

This data record is for thruster number 04.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 04" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 04. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 04. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 04. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 04. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 04. |

### 4.2.2.10. Data Record 7

This data record is for thruster number 05.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 05" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 05. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 05. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 05. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 05. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 05. |

### 4.2.2.11. Data Record 8

This data record is for thruster number 06.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 06" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 06. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 06. |

| | | |
|---|---|---|
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 06. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 06. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 06. |

### 4.2.2.12. Data Record 9

This data record is for thruster number 07.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | 'THRUSTER 07" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 07. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 07. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 07. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 07. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 07. |

### 4.2.2.13. Data Record 10

This data record is for thruster number 08.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 08" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 08. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 08. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 08. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 08. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 08. |

### 4.2.2.14. Data Record 11

This data record is for thruster number 09.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 09" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 09. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 09. |

| | | |
|---|---|---|
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 09. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 09. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 09. |

### 4.2.2.15. Data Record 12

This data record is for thruster number 10.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | 'THRUSTER 10" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 10. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 10. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 10. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 10. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 10. |

### 4.2.2.16. Data Record 13

This data record is for thruster number 11.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 11" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 11. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 11. |
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 11. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 11. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 11. |

### 4.2.2.17. Data Record 14

This data record is for thruster number 12.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | ‘THRUSTER 12" | Record label. This record is always present, even if thruster is inactive. |
| 12-12 | " " | Blank space |
| 13-23 | "NO._PULSES=" | Label to indicate the number of pulses fired during the course of a single desaturation event. |
| 24-26 | I3 | Integer number of pulses for thruster 12. If = 0, this thruster is inactive. If not = 0, thruster is active. |
| 27-27 | " " | Blank space |
| 28-36 | "DEADTIME=" | Label to indicate time between pulses for thruster 12. |

| | | |
|---|---|---|
| 37-41 | F5.2 | Time in seconds between pulses. |
| 42-42 | " " | Blank space |
| 43-53 | "PULSEWIDTH=" | Label of the width or span of the pulse for thruster 12. |
| 54-58 | F5.3 | Duration or width of the pulse of the active thruster in seconds. |
| 59-59 | " " | Blank space |
| 60-71 | "IMPULSE BIT=" | Label specifying the impulse per pulse for thruster 12. |
| 72-79 | F8.5 | Value of the impulse/pulse in "Newton seconds" for active thruster 12. |

### 4.2.2.18. Data Record 15

Data record 15 specifies the quaternion relating spacecraft axes to J2000 coordinates at the event start time. This quaternion represents the spacecraft orientation at the start of the desaturations.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-11 | "QUATERNION=" | Record label |
| 12-12 | " " | Blank space |
| 13-21 | F9.6 | Value of 1st quaternion component = a. |
| 22-22 | " " | Blank space |
| 23-31 | F9.6 | Value of 2nd quaternion component = b. |
| 32-32 | " " | Blank space |
| 33-41 | F9.6 | Value of 3rd quaternion component = c. |
| 42-42 | " " | Blank space |
| 43-51 | F9.6 | Value of 4th quaternion component = d. |

Where
$a = e_1 \sin(\phi/2)$,
$b = e_2 \sin(\phi/2)$,
$c = e_3 \sin(\phi/2)$, *and*
$d = \cos\phi/2$.

### 4.2.2.19. Data Record 16

Data record 16 specifies the spacecraft spin rate at the start of desaturation.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-17 | "S/C ANGULAR RATE" | Record label. Angular rate values are applicable to the start of desaturations and are needed for all AACS modes, including mapping. The angular rate is broken into 3 components along the body frame or spacecraft axes. |
| 18-18 | " " | Blank space |
| 19-23 | "ROLL=" | Label representing the spin rate about the spacecraft roll (x) axis. |
| 24-30 | F7.4 | Value of the spin rate about the s/c roll axis in deg/sec. |
| 31-32 | " " | 2 blank spaces |
| 33-38 | "PITCH=" | Label representing the spin rate about the spacecraft pitch (y) axis. |
| 39-45 | F7.4 | Value of the spin rate about the s/c pitch axis in degrees/sec. |
| 46-47 | " " | 2 blank spaces |
| 48-51 | "YAW=" | Label representing the spin rate about the s/c yaw (z) axis. |
| 52-58 | F7.4 | Value of the spin rate about the s/c yaw axis in deg/sec. |

### 4.2.2.20. End of File Record

The End-of-File Record indicates the end of file.

| COLUMNS | CONTENT | DESCRIPTION |
|---|---|---|
| 1-5 | "$$EOF" | Signifies end of data |

NOTE: The three (3) header, sixteen (16) data, and one (1) end of file records may be repeated as many times as there are AMD events to be recorded. See Appendix, Sample Wrapped File, below.

# Appendix A. SAMPLE WRAPPED FILE

A sample wrapped Angular Momentum Desaturation file is provided in order to show the expected format of the data. The user should not code specifically to the real numbers as printed.

```
CCSD3ZS00001AAAAAAAANJPL3KS0L015BBBBBBBB
MISSION_NAME=MARS_GLOBAL_SURVEYOR
SPACECRAFT_NAME=MARS_GLOBAL_SURVEYOR
DATA_SET_ID=ANGULAR_MOMENTUM_DESAT;
FILE_NAME=amdfile.x;
PRODUCER_ID=EAS;
APPLICABLE_START_TIME=1993-001T00:00:00.000;
APPLICABLE_STOP_TIME=1993-001T15:38:31.800;
PRODUCT_CREATION_TIME=1990-12-21T10;43;00;
CCSD3RE00000BBBBBBBBNJPL3IS00255CCCCCCCC
* ANGULARMOMENTHISTORY DATA
* CREATION: SCT 21-DEC-1990 10:43:00
* SAMPLE AMD FILE - OFF SPIN AXIS
STRT_TIME = 93-001/00:00:00.000
STOP_TIME = 93-001/00:04:03.100
THRUSTER 01 NO._PULSES= 31 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 02 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 03 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 04 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 05 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 06 NO._PULSES= 31 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 07 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 08 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 09 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 10 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 11 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 12 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
QUATERNION=  0.250000  0.250000  0.353553  0.866025
S/C ANGULAR RATE  ROLL= 0.0000  PITCH=-0.0510  YAW= 0.0000
$$EOF
* ANGULARMOMENTHISTORY DATA
* CREATION: SCT 10-DEC-1990 13:14:33
```

```
* SAMPLE AMD FILE - SPIN AXIS
STRT_TIME = 93-001/03:54:00.000
STOP_TIME = 93-001/03:57:02.900
THRUSTER 01 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 02 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 03 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 04 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 05 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 06 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 07 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 08 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 09 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 10 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 11 NO._PULSES= 23 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 12 NO._PULSES= 23 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
QUATERNION=  0.250000  0.250000  0.353553  0.866025
S/C ANGULAR RATE  ROLL= 0.0000  PITCH=-0.0510  YAW= 0.0000
$$EOF
* ANGULARMOMENTHISTORY DATA
* CREATION: SCT 10-DEC-1990 13:23:20
* SAMPLE AMD FILE - NEG PITCH UNLOAD
STRT_TIME = 93-001/07:48:00.000
STOP_TIME = 93-001/07:51:27.800
THRUSTER 01 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 02 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 03 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 04 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 05 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 06 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 07 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 08 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 09 NO._PULSES= 26 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
```

```
THRUSTER 10 NO._PULSES= 26 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 11 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 12 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
QUATERNION=  0.250000  0.250000  0.353553  0.866025
S/C ANGULAR RATE  ROLL= 0.0000  PITCH=-0.0510  YAW= 0.0000
$$EOF
* ANGULARMOMENTHISTORY DATA
* CREATION: SCT 10-DEC-1990 13:40:09
* SAMPLE AMD FILE - YAW/PITCH UNLOAD
STRT_TIME = 93-001/11:42:00.000
STOP_TIME = 93-001/11:44:09.700
THRUSTER 01 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 02 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 03 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 04 NO._PULSES= 17 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 05 NO._PULSES= 17 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 06 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 07 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 08 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 09 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 10 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 11 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
THRUSTER 12 NO._PULSES=  0 DEADTIME= 8.0 PULSEWIDTH=0.30 IMPULSE BIT=
0.26400
QUATERNION=  0.250000  0.250000  0.353553  0.866025
S/C ANGULAR RATE  ROLL= 0.0000  PITCH=-0.0510  YAW= 0.0000
$$EOF
* ANGULARMOMENTHISTORY DATA
* CREATION: SCT 10-DEC-1990  14:43:03
* SAMPLE AMD FILE - YAW EMERGENCY UNLOAD
STRT_TIME = 93-001/15:36:00.000
STOP_TIME = 93-001/15:38:31.800
THRUSTER 01 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 02 NO._PULSES= 38 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 03 NO._PULSES= 38 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 04 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
```

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THRUSTER 05 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 06 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 07 NO._PULSES= 38 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 08 NO._PULSES= 38 DEADTIME= 4.0 PULSEWIDTH=0.10 IMPULSE BIT=
0.44000
THRUSTER 09 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.50 IMPULSE BIT=
0.44000
THRUSTER 10 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.50 IMPULSE BIT=
0.44000
THRUSTER 11 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.50 IMPULSE BIT=
0.44000
THRUSTER 12 NO._PULSES=  0 DEADTIME= 4.0 PULSEWIDTH=0.50 IMPULSE BIT=
0.44000
QUATERNION=  0.250000  0.250000  0.353553  0.866025
S/C ANGULAR RATE  ROLL= 0.0000  PITCH=-0.0510  YAW= 0.0000
$$EOF
CCSD3RE00000CCCCCCCCCCSD3RE00000AAAAAAAA
```